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FLIGHT PROBLEMS, PROBLEMS IN STARTING SERVICE, (U)

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FOREIGN TECHNOLOGY DIVISION

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By

A. Olesinski, A. Slodownik

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FLIGHT PROBLEMS, PROBLEMS IN STARTING SERVICE by Andrzej Olesinski, M.Eng. and Andrzej Slodownik, M.Eng.

The basic tasks in starting service in the process /10 of preparing aircraft for flight. Dependence of degree of utilization of equipment and regularity of flight on coefficients characterizing aircraft on ground: in technological service, in waiting for flight and during flight.

It is the task of the starting service to prepare aircraft to transport a definite number of passengers or a definite amount of cargo. Preparation of an aircraft for transportation is an integral part of the transfer process beginning from the moment a passenger enters the airport building and ending when he leaves the airport after his flight. Preparation of an aircraft for flying is a service-use process achieved through specialized services of the airline enterprise. Basic operations in this process include: technical starting service, external aircraft service, passenger and baggage transportation traffic service, loading and unloading transported goods, catering service (food on board), cleaning up and providing the aircraft with on-board apparatus and fueling the tank. The operations mentioned constitute an intregal part of the other processes achieved in the enterprise and associated with aircraft utilization. This relationship can be presented with the aid of an idealized chart (Figure 1).

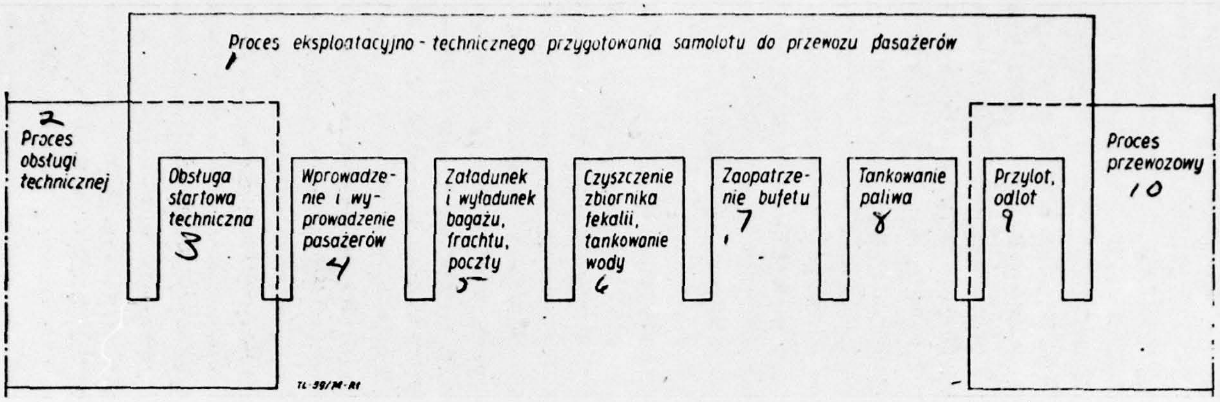

Figure 1. Idealized chart of the technological-use process of preparing aircraft to carry passengers.

Key: 1-technological-use process of preparing aircraft to carry passengers, 2-technological service process, 3-technical starting service, 4-boarding and unboarding passengers, 5-loading and unloading baggage, freight, mail, 6-cleaning rest room receptacles filling water tank, 7-food supplies, 8-filling fuel tank, 9-arrival, departure, 10-shipping process.

All operations in the process of preparing aircraft for flight depend on many different factors, but the dependence on the kind of apparatus available is fundamental. This dependence is strongest in the case of the technical starting service. The economic requirements presenting the aircraft enterprise with the task of maximum utilization of apparatus, while at the same time meeting the conditions of high flight regularity, impose upon the technical starting service tasks which are more and more difficult, because

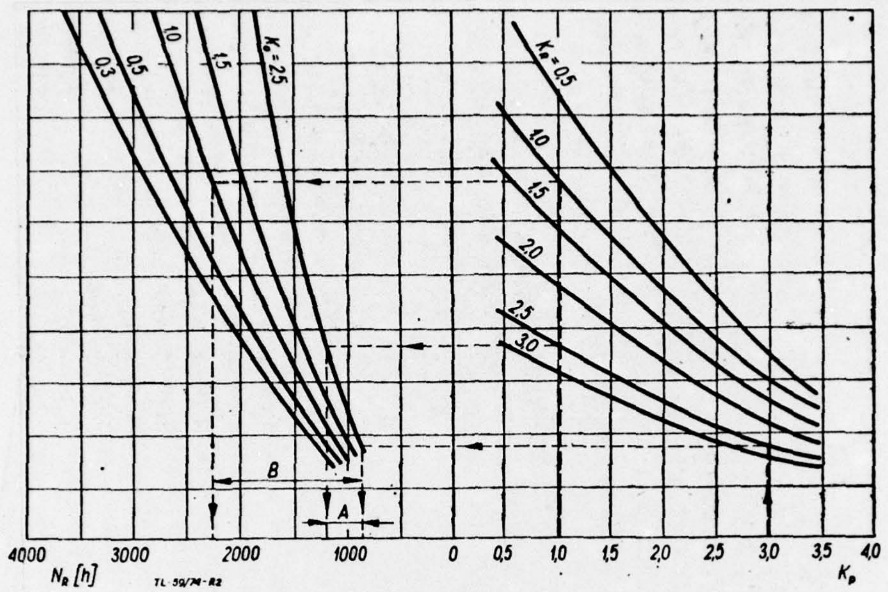

Figure 2. Normogram for determining possible yearly flights N_R as a function of K_p, K_o, K_R.

the time the aircraft stays on the ground in the airport between two successive flights continually becomes shorter.

The concepts mentioned above of aircraft utilization and flight regularity require further explanation to demonstrate the effect they have on the process of preparing aircraft for flight.

Among others, one standard for apparatus utilization is the annual flight* hours per aircraft on hand. [*Editorial note: instead of the term flight, it would be better to use number of hours flown]. This flight depends mainly upon the kind of apparatus available, but also on the time the aircraft is completely and technically ready to fly, the time the aircraft spends in flight and the time spent in periodic examinations and elimination of defects.

This dependence can be presented in the following equation:

$$N_R = \frac{8760}{K_p + K_o + K_R + 1}$$

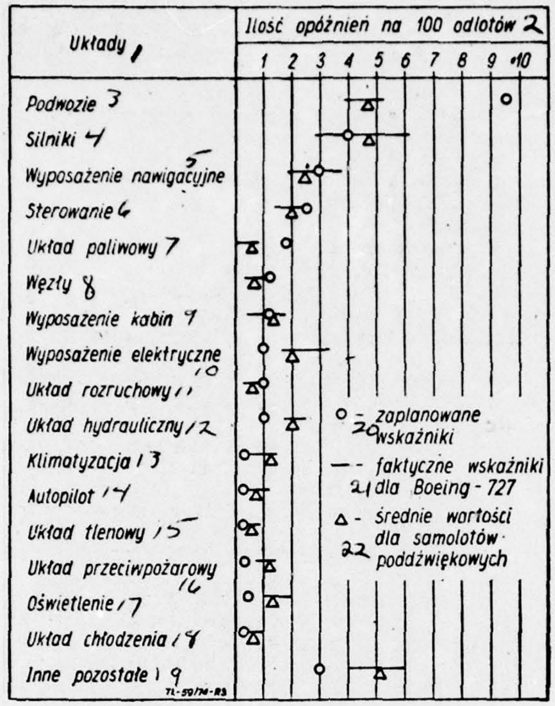

Figure 3. Data on delays produced for technical reasons in the departure of aircraft of airline companies in the U.S.A.
Key: 1-systems, 2-number of delays per 100 departures, 3-landing gear, 4-engines, 5-navigational equipment, 6-control, 7-fuel system, 8-connections, 9-cabin equipment, 10-electrical equipment, 11-starting system, 12-hydraulic system, 13-air conditioning, 14-automatic pilot, 15-oxygen system, 16-fire control system, 17-lighting, 18-cooling system, 19-miscellaneous, 20- plan indicators, 21-actual indicators for Boeing 727, 22-mean values for subsonic aircraft.

where: N_R is the yearly flight hours per airplane on hand; K_p is the coefficient characterizing aircraft non-flight time during technical service (starting and periodic examinations, elimination

Table: Comparison of selected parameters of subsonic and supersonic aircraft service.

Wskaźnik 1	Samolot naddźwiękowy 2	Współczesny samolot pasażerski 3
Regularność lotów [%] 4	99	96
Czas postoju w portach podczas wykonywania rejsu [min] 5	30/20	30
Czas postoju w portach macierzystych [min]	90/30	50 ÷ 90
Roczny nalot samolotu [h] 7 6	3 300	3 300
Całkowity resurs [h] 8	50 000	36 000
Nakład na obsługę techn. i remont na 1 godz. lotu [rbg/h] 9	19,31	13,8
Średni czas usuwania nagłych usterek w okresie międzyprzeglądowym [min] 10	30	—

Key: 1-indicator, 2-supersonic aircraft, 3-contemporary passenger aircraft, 4-regularity of flight, (percentage), 5-time spent in airports during a flight (min), 6-time spent in home airport (min), 7-yearly aircraft traffic (h), 8-total service life (h), 9-outlay for technological service and repair per hour of flight (rbg/h), 10-mean time for eliminating sudden defects during intermediate inspection (min).

of defects) and during repair (in respect to one flight hour); K_o is the coefficient characterizing non-flight time of technically prepared aircraft waiting for flight (in respect to one hour of flight); K_R is the coefficient characterizing aircraft time spent in flight (in reference to one flight hour).

The diagram (Figure 2) shows the dependence of the possible flight hours (aircraft utilization) on the coefficients K_p, K_o and

K_R.

The result of the dependencies presented is that the most effective increase in N_R will take place after the execution of such technological and organizational solutions, after which there will be a simultaneous decrease in coefficients K_p, K_o and K_R. The result of this is that the time spent in ma ing periodic examinations and starting examinations and the time used for eliminating defects should be reduced to the minimum, just like the non-flight/11 time of aircraft technologically ready and during flight.

In turn, by flight regularity we mean the ratio between the number of flights carried out precisely according to plan and the total number of flights planned in a period of time. Occurring delays or cancellations, which have an effect in reducing flight regularity, are produced by various causes which are not always dependent on the aircraft enterprise, its organization or the aircraft apparatus available. Nevertheless, unexpected defects in aircraft apparatus have a decisive effect in reducing flight regularity. In turn, the number of aircraft apparatus defects is associated with the intensity of its use, namely, the greater the use intensity, the greater the number of defects. As a result, demand for increasing aircraft apparatus usage, while at the same time preserving high flight regularity, leads to the fact that the technical starting service, having a shorter and shorter time for preparing aircraft for flight, must pinpoint and remove defects so as to guarantee punctual aircraft departure. In practise this is a very difficult task because the shorter the time an aircraft is

out of flight in the technical starting service, the less the probability of timely elimination of a technological defect critical for flight.

For modern aircraft the time of stay in airports amounts to from 40 - 60 minutes. For newly designed and constructed types of aircraft, the ground time is assumed to be around 30 minutes, with the assumption that there will not be more than one delay for technological reasons in 100 departures. These are very high indices, requiring intensive action on the part of designers, in the direction of special preparation in aircraft construction for easy pinpointing and elimination of defects. Figure 3 contains current data about U.S.A. aircraft departure delays for technological reasons.

The probability of a successive aircraft departure at the designated time (R_o) can be noted as a function of the probability R_R of defect-free work of the assemblies and parts of the aircraft in the previous flight (R_R), the probability of the presence in the landing airport of an unoccupied team of specialists R_{SB}, and the probability R_U of eliminating a sudden defect in time τ R_U not exceeding the given on-ground time t_{zad}, i.e. $R_U \{ \tau \leqslant t_{zad} \}$.

This dependence can be expressed in the following equation:

$$R_o = 1 - [(1 - R_R) \cdot (1 - R_{SB} \cdot R_U)],$$

Taking for granted the requirement of the presence in the landing airport of an unoccupied team of specialists to remove defects, the probability of aircraft departure at time R_o is dependent on the probability of timely elimination of an unexpected defect.

This is the most important task for the technical starting service. This task is even more complex because it involves conditions for introducing into practical usage the methods of the technical aircraft service according to the factual technological condition. For simplification, and especially to make this task possible, designers of aircraft and their accessories have begun to use modular construction.

This process is currently most advanced in respect to aircraft accessories, where modular construction permits rapid location and elimination of defects by just exchanging a block. According to western sources on currently existing English types of aircraft, VC-10 and BAC-111, about 70% of the assemblies, sets and blocks /12 can be exchanged in a single hour in case of defects. Furthermore, in the newly constructed L-1011 aircraft of the Lockheed Company, about 90% of the assemblies, sets and blocks can be replaced within a single hour. This company has defined the regularity of L-1011 aircraft flights as 99%, with its gradual increase in the process of utilization to 99.85%, which means 15 flights cancelled for technological reasons out of 10,000 planned flights.

The table mentions some requirements levied on supersonic passenger aircraft, partly referring to flight regularity, utilization and technical service. These requirements are an expression of the problems and tasks facing the starting service, which is responsible for the safety of aircraft transportation.

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